Desktop Card Printer With Embedded PCL®, Telnet, and USB Hub and Method for Using Same

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Background of the Invention

Field of the Invention

The invention relates to a desktop card printer, and a method for printing cards therewith. More particularly, the invention relates to a desktop card printer that includes embedded PCL® (Printer Control Language), Telnet Protocol, and an internal

10　Universal Serial Bus (USB) hub.

Description of Related Art

Presently, cards of various sorts, such as identification cards, pass cards, credit cards, etc. are in wide use. Many such cards incorporate some form of data thereon or therein, such as textual or graphical printing, or information stored in a

15　magnetic stripe on the card. More recently, it has become known to embed computer chips in cards to produce so-called "smart cards", and to record data and/or functional instructions or programs on the chips.

Often, it is desirable to customize the data stored on a card in some fashion. For example, an identification card might include the card-bearer's name and

20　photograph. Alternatively, information about the bearer, access codes, etc. might be stored in magnetic stripes or in computer chips. A given card may include several types of data stored thereon.

Until relatively recently, the chief means for adding information to cards is through the use of large industrial-style machinery. Such machinery is suited to

25　processing very large numbers of cards in a short period. However, as cards become common, smaller card printers have become desirable. Sometimes referred to as "desktop card printers", they typically are smaller, more mobile, and less expensive than

industrial card printers. The use of desktop card printers can facilitate rapid and convenient production of cards in small batches or even singly.

However, conventional desktop card printers have several limitations.

For example, conventional desktop card printers often are used in
5   conjunction with desktop card printers, in order to control the printers and provide a convenient vehicle for users to enter the data that is to be written on the cards. Computers used in such a role sometimes are referred to as "host" machines. In order for a host and a desktop card printer to communicate, they must have some common language.

10   Conventionally, languages used with desktop card printers are platform-specific. That is, they are designed to work only with a single operating system. In order to control a conventional desktop card printer with a personal computer that has an alternate operating system, additional software is required. For example, the appropriate printer drivers could be "ported" to the alternate operating system by
15   rewriting and modifying their code.

The modifications necessary to use a platform-specific language on a different platform can interfere with the operating system, causing crashes or other problems. Even if this can be overcome, time and effort is required to produce and debug the new software.

20   In addition, conventional desktop card printers require much of the image handling work to be performed by the host computer. For example, if a photograph is provided to a conventional desktop printer, the host must instructed the printer whether the image itself is color or black and white, which print ribbon(s) should be used if the printer has the capability to print in multiple modes, etc. A single printing
25   may require many such decisions.

The need for the host computer to handle the decision-making and image-processing functions can slow down printing, and/or occupy the host to such an extent that it cannot effectively perform other tasks (such as new data entry) while printing.

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In addition, if the host computer is handling the decision-making and processing, the host may have to obtain specialized information about the printer and its status in order to do so. For example, certain inks may be useful only for cards made of certain materials. If a printer has several ink cartridges for different types of card, the host would have to "know" which is the proper ink cartridge for the type of card being printed. To obtain this information, the host would have to communicate with the card printer itself - perhaps further slowing down printing and host operation - or interrogate the host's operator. In the latter case, the level of skill required to operate the desktop card printer increases.

In addition to a common language, a host and a desktop card printer must share a communication protocol. Conventional desktop card printers commonly use a Universal Serial Bus, or USB connection. However, USB connections generally are possible only as direct links. That is, the host must be connected directly to the desktop card printer with a USB cable. This makes it difficult or impossible to use a conventional desktop card printer equipped only with a USB-port over a network, or otherwise from a distance beyond the reach of a standard USB cable.

Card printers may record data of several types. For example, as noted above a desktop card printer may record on a single card a visible image, data in a magnetic stripe, and data in a smart card chip. However, a desktop card printer with multiple data writers (i.e. a print head, a magnetic write head, and a smart card contact) must be able to control each of those data writers. In conventional desktop card printers, some or all of the data writers use independent communication connections, in addition to the main connection(s) for the printer as a whole. As a result, a single conventional card printer may include as many as five or more separate connections (i.e. USB cables). Installation and use of the card printer thus may become increasingly complex as more data writers are added. Although third-party hubs may be used to consolidate the connections, this may not be a sufficient solution, since in that case the hub itself also must be connected.

Summary of the Invention

It is the purpose of the claimed invention to overcome these difficulties, thereby providing an improved desktop card printer, and a method for using the same.

As a preliminary matter, the following terms are defined.

5   The term "desktop card printer" as used herein to describe the present invention should be considered to mean a device suitable for desktop use, for disposing data on cards. Industrial card printers typically are much larger than desktop card printers. In addition, industrial card printers may be very different in structure, operation, and application from desktop card printers, and as such industrial card

10 printers per se are not considered to be part of the present invention.

The term "printer" sometimes is used to refer specifically to a device for printing text or graphics, that is, visible images. However, with respect to the present invention the term "printer" refers more broadly to a device for deposition of data on a card. The type of data is not particularly limited. A printer may print text or graphics,

15 but printing may include visible information that is neither pictorial nor textual, such as a bar code, in addition to or as an alternative to text and graphics.

Furthermore, recording information that is not necessarily visible to the human eye also may be considered printing for purposes of this application. For example, a desktop card printer may include a magnetic write head for recording

20 magnetic data, either digital or analog; writing such data to the card is considered printing herein. Likewise, recording data to a computer chip embedded in a smart card also would be considered printing.

In addition, although the term "printer" sometimes is used to describe paper printers, a desktop card printer is not necessarily analogous in structure or

25 function to a paper printer. Although certain terminology may be similar for paper and card printers, the devices themselves may not be similar. Therefore, unless otherwise noted herein, similarity or equivalence of a desktop card printer in accordance to the principles of the present invention to a paper printer should not be presumed.

As one instance, where paper printers typically print only on paper or on paper-like media, card printers may print on a very wide variety of media. Certain of these materials, such as many plastics, require the use of printing methods and/or inks that are very different from those used in paper printers. For example, while for color

5   paper printers that use CYMK (cyan-yellow-magenta-black) colors, it may be equivalent to print black either as a combination of cyan, yellow, and magenta or as black. However, this is not necessarily true for card printers; therein, a combination of cyan, yellow, and magenta will not necessarily be equivalent to black. Thus, although a card printer may be used to print data that includes black, the manner in which this is

10   done and the structure used to do it will not necessarily be equivalent, or even especially similar.

Similarly, it is noted that individual card printers may include several types of data writing devices, such as magnetic write heads, contacts for smart card chips, etc. in addition to print heads, while paper printers typically include print heads

15   only.

Further information regarding such distinctions between paper and card printers is provided in the detailed description.

An exemplary embodiment of a desktop card printer in accordance with the principles of the present invention includes an external communication link for

20   communication between the printer and external agencies, including but not limited to a host computer. The printer also includes a multi-platform standardized PDL (Page Description Language) controller in communication with the communication link, and at least one data writer in communication with the controller. The controller controls the data output of the data writer.

25   More particularly, the PDL controller may be a PCL® (Printer Control Language) controller.

Data writers may include print heads, magnetic write heads, and smart card contacts. The printer may include more than one data writer, with the controller controlling the data outputs of each.

When desktop card printer includes a smart card contact as a data writer, the printer may include a coupler. The coupler may be in communication with the controller, as well as with the smart card contact, such that the controller controls the data output of the contact via the coupler.

5   The desktop card printer may include more than one coupler, each of them in communication with the controller, such that the controller controls the data output of the smart card contact via a coupler selected from among several alternatives.

The data writers of the printer may include a first mode print head that prints in a first mode, and a second mode print head that prints in a second mode, 10   wherein the first and second print modes are different. The first mode print head may be a dye sublimation printer, and the second mode print head may be a resin-ink surface printer.

Another exemplary embodiment of a desktop card printer in accordance with the principles of the present invention includes an external communication link for 15   communication between the printer and external agencies, a multi-platform standardized PDL controller in communication with the communication link, and at least one data writer in communication with the controller. The controller controls the data output of the data writer. The communication link may be an Ethernet link, and the controller may be a Telnet controller.

20   Yet another exemplary embodiment of a desktop card printer in accordance with the principles of the present invention includes a Universal Serial Bus (USB) hub internal to the printer. The printer also includes a smart card contact, and two or more couplers. The couplers are in communication with the USB hub and the smart card contact. Via the USB hub, one coupler may be selected from among the 25   couplers, and that coupler then may be used to control the data output of the smart card contact.

The USB hub may be electronically integrated into the desktop card printer.

An exemplary embodiment of a method of card printing in a desktop card printer in accordance with the principles of the present invention comprises the following. A controller of the printer is commanded from a host so that the host controls the controller, the commands being issued to the controller using a multi-platform standardized PDL. The commands from the host are interpreted with the controller, and the controller commands at least one data writer so as to control the data writer. Data then is written to a card in the card printer using the data writer.

The controller may be commanded using PCL®.

The data writers may include print heads, magnetic write heads, and smart card contacts.

The desktop card printer may include two or more data writers. In such case, the method may include selecting a data writer with the controller, commanding the selected data writer with the controller so as to control the selected data writer, and writing data to the card using the selected data writer.

Alternatively, if the desktop card printer includes two or more data writers, the method may include selecting first and second data writers with the controller, selectively commanding the selected data writers with the controller so as to selectively control them, and selectively writing data to the card with the selected data writers.

The method may include commanding a coupler in the printer with a host so as to control the coupler. The coupler interprets the commands from the host, and commands a smart card contact so as to control the smart card contact. The smart card contact then writes data to a card in the printer.

The method may include commanding the controller in the printer with a host via a USB hub internal to the desktop card printer, so as to control the controller, and commanding a coupler in the printer via the USB hub so as to control the coupler from the host. The coupler interprets the commands from the host, and commands a smart card contact so as to control the smart card contact. The smart card contact then writes data to a card in the printer.

The controller may be commanded via a network. The controller may be a Telnet controller, and the controller may be commanded using Telnet protocol.

Brief Description of the Drawings

Like reference numbers generally indicate corresponding elements in the

5   figures.

Figure 1 shows a perspective illustration of an exemplary embodiment of a desktop card printer in accordance with the principles of the present invention.

Figure 2 shows a schematic representation of an exemplary embodiment of a desktop card printer in accordance with the principles of the present invention.

10   Figure 3 shows a schematic representation of another exemplary embodiment of a desktop card printer in accordance with the principles of the present invention.

Figure 4 shows a schematic representation of yet another exemplary embodiment of a desktop card printer in accordance with the principles of the present

15   invention.

Detailed Description of the Preferred Embodiment

Figure 1 shows an exemplary embodiment of a desktop card printer 10 in accordance with the principles of the present invention. As may be seen therefrom, the desktop card printer 10 is a generally self-contained unit. As such, it may be used as a

20   peripheral to a desktop computer or similar device in a "desktop" environment, similarly to other peripherals such as scanners, etc. However, although the desktop card printer 10 is suited particularly to the desktop environment, it is not otherwise particularly limited in terms of its structure or application.

Figure 2 shows a schematic representation of an exemplary embodiment

25   of a desktop card printer 10 in accordance with the principles of the present invention.

As may be seen therein, the desktop card printer 10 includes an external communication link 12, a controller 14, and at least one data writer 16.

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The external communication link **12** enables communication with devices external to the printer **10**. For example, as illustrated, the printer **10** is connected to a host computer **30** by way of the external communication link **12**. In such an arrangement, the host computer **30** may serve as a convenient interface with the printer **10**.

For example, the host **30** may be used to conveniently input data regarding the printing to be done, such as the number, color, and placement of images or other data. Such data is then relayed to the printer **10** via the external communication link **12**. Likewise, data from the printer **10**, such as error messages, notification that a particular print job is complete, etc., may be relayed to the host **30** via the external communication link **12**.

However, neither the printer **10** nor the external communication link **12** are limited only to connection with a host computer **30**.

A variety of connections may be suitable for use as the external communication link **12**. With regard to the physical structure of the link, Ethernet and USB ports are known to be useful as external communication link **12**. However, this is exemplary only, and other links may be equally suitable.

In particular, although the external communication link **12** is shown with a wire link to the host **30**, an external communication link **12** utilizing wireless communication may be equally suitable. It is noted that the term "external" when used herein with regard to the external communication link **12** refers to external communication, that is, communication into or out of the desktop card printer **10**. Although the external communication link **12** also may be external in the sense that they are on the outside of the printer **10**, this is not required. For example, with some forms of wireless communication the external communication link **12** may be fully enclosed within the printer **10**, rather than reaching the exterior of the printer **10**.

Suitable external communication links are known per se, and are not described further herein.

The controller **14** is in communication with the external communication link **12**. Thus, data may be sent and received by the controller **14** to and from the host **30** or another external entity via the link **12**.

Preferably, the controller **14** is a multi-platform standardized PDL (Page
5 Description Language) controller. That is, it is preferable that the controller **14** can send and/or receive commands using a standardized PDL that is usable on more than one type of computer system.

In some embodiments of the desktop card printer **10**, the controller **14** may be a multi-platform standardized PDL controller by virtue of its physical structure.
10 That is, the controller **14** may be constructed specifically to utilize a multi-platform standardized PDL, and/or the PDL may be permanently and unalterably embedded within the controller **14**.

However, this is not required. A controller **14** that has a suitable PDL embedded therein as firmware, or that loads such a PDL as software in order to control
15 the desktop card printer **10**, may be equally suitable. It is emphasized that for the purposes of the present invention, such a controller **14** is still considered to be a multi-platform standardized PDL controller, even if it is not structurally identifiable as such. It is sufficient that that controller sends and/or receives information in a multi-platform standardized form.

20 Some embodiments of a desktop card printer **10** in accordance with the principles of the present invention may use a semiconductor chip as a controller **14**. However, this is exemplary only, and other controllers may be equally suitable.

In a preferred embodiment, the controller **14** has a multi-platform standardized PDL protocol embedded therein as firmware, in ROM (Read Only
25 Memory). Such an arrangement does not require a job-specific controller to be designed and constructed only for PDL use. In addition, when embedded as firmware the PDL is relatively stable; for example, ROM is non-volatile, and so the data comprising the PDL is resistant to accidental loss or modification when stored therein.

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In the case wherein the controller **14** has the PDL embedded in ROM thereof as firmware, it also is preferred that the ROM be PROM (Programmable Read Only Memory), so that the firmware instructions comprising the PDL can be updated, modified, or expanded if necessary.

5   In a more preferred embodiment, the controller is a PCL® (Printer Control Language) controller. PCL® is a registered trademark of Hewlett-Packard. PCL® is an example of a multi-platform standardized PDL.

In a still more preferred embodiment, an extended version of PCL® is used; that is, extensions are used in conjunction with the base version of PCL® to

10   enable functions not available in the base version of PCL®. It is noted that PCL® is employed to control paper printers, and as of the filing date of this application it does not provide for at least some functions of the present invention. For example, as of the filing date of this application PCL® does not provide for the use of magnetic write heads or smart card contacts as data writers. This feature thus is not available using the

15   base version of PCL®. Extensions that enable this and other features may be utilized by the controller **14** so as to provide additional functionality that is required or desirable in the desktop card printer **10**.

PDLs and PCL® are known per se, and are not further described herein.

It is also preferred that the controller **14** is a Telnet device. That is, the

20   controller **14** has Telnet embedded therein, so that information may be transmitted to and from the controller **14** (for example via the external communication link **12**) using Telnet protocols.

As with the use of a PDL, the manner in which the controller **14** has Telnet made available to it is not particularly limited. Telnet protocols may be

25   incorporated into the structure of the controller **14**, into firmware therein, or as software therein. Any such controller **14** may be considered a Telnet controller for purposes of this application, so long as it provides Telnet functionality.

Telnet enables convenient connection of the desktop card printer **10** with a network. Thus, several hosts **30** might have access to a single desktop card printer **10**,

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and likewise several desktop card printers **10** might be accessed by a single host **30**. In addition, Telnet enables remote access to a desktop card printer **10** that is on such a network from substantially any place the network itself may be accessed.

Figure 5 shows one such network. Therein, six hosts **30A** through **30F** are linked together in a network along with two desktop card printers **10A** and **10B**. In such an arrangement, any of the six hosts **30A** through **30F** can access and print with either of the desktop card printers **10A** and **10B**. However, this arrangement is exemplary only. Networks and the arrangement of desktop card printers **10** within them may vary widely.

Returning to Figure 2, the controller **14** is in communication with at least one data writer **16**. As illustrated in Figure 2, the controller is in communication with four data writers **16A**, **16B**, **16C**, and **16D**, although this is exemplary only.

It is noted that communication between the controller **14** and data writers **16** need not be direct. For example, as shown the controller **14** is in communication with data writer **16D** via couplers **18A**, **18B**, and **18C**. The couplers **18** are described in more detail below.

The controller **14** controls the data output of the data writers **16**, and hence controls what data eventually is deposited on or a the card passing through the printer **10**. As noted above, the controller **14** is in communication with the external communication link **12**, so that data may in turn be provided to the controller **14**.

As noted previously, a card printer **10** in accordance with the principles of the present invention is not limited only to visible printing of graphics or text. Rather, substantially any form of data may be deposited on or in a card. Likewise, for the purposes of the present invention, a data writer **16** may be substantially any device that writes data either to the surface of a card or into some data storage system within the card. Data writers **16** are not particularly limited as to structure, manner of operation, or type of data written.

Suitable data writers **16** include, but are not limited to, print heads, magnetic write heads, and smart card contacts.

The type of data writers 16 in a desktop card printer 10 in accordance with the principles of the present invention determine the sort of data that may be written. For example, print heads typically print text, graphics, or other data such as bar codes on exposed card surfaces. Magnetic write heads typically record data on stripes

5   of magnetic material applied to the surface of a card, or encapsulated within the card. Smart card contacts typically record data on computer chips attached to or embedded within a card.

A desktop card printer 10 in accordance with the principles of the present invention may include any or all of the above types of data writer 16, and/or data

10   writers 16 not specifically described herein.

In addition, a particular embodiment of the desktop card printer 10 may include multiple data writers 16 of a particular type. In such instance, those data writers 16 may be identical, or they may differ from one another.

For example, a particular printer 10 may include as data writers 16 both a

15   color print head, such as one that prints in CYM (cyan-yellow-magenta) format, and a black-and-white print head that prints only in black.

This specific arrangement may be of particular interest with regard to card printing, since the inks used for printing onto many card materials (such as various plastics) interact in ways that may be non-intuitive. For example, for media such as

20   paper CYM printing can produce black by combining cyan, yellow, and magenta inks. However, in card printing this will not necessarily be the case; even if the resulting combination may be considered to be black upon inspection, the print quality produced may differ significantly from that produced by printing with a black ink.

As another example, the printer 10 may include as data writers 16 print

25   heads that print in different modes. The printer may include a first mode print head may be a dye sublimation print head. Such a print head deposits dyes on the surface of a card, and the dyes penetrate into the card material, typically (though not necessarily) with the application of heat. The printer 10 also may include, in addition to the dye sublimation print head, a resin print head as a second mode print head. A resin print

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head deposits colored resin onto the surface of a card; the resin typically fuses to the surface with the application of heat, but does not penetrate into the card material.

Even if the printing produced by the two print heads were visually identical, a printer **10** might include different print heads for printing in different modes

5   if the resulting image had different non-visual properties. For example, dyes that cannot be read by a bar-code reader might be used to produce a visible image, which resin that can be used might be used to produce bar codes. With such a combination, the resin-printed bar code could be easily read by a bar code reader even if a visible dye image were also present, perhaps even overlapping the bar code itself.

10   Likewise, a desktop card printer **10** in accordance with the principles of the present invention may include as data writers **16** both an analog magnetic write head and a digital magnetic write head. With such an arrangement, analog data could be written to magnetic stripes on some cards, while digital data might be written to other cards. Alternatively, both analog and digital data might be written to a single card.

15   Similarly, a desktop card printer **10** might include as data writers **16** two or more types of smart card contact. For example, the smart card chips in some smart cards are designed to receive data through direct electrical contacts on the card surface, and a contact suitable for writing data to such cards might be included in the printer **10** as a data writer **16**. However, the chips in other smart cards are designed to receive data

20   wirelessly, i.e. via radio waves. Thus, a radio antenna also might be included as a data writer **16** in order to write data to the chips in such cards.

Returning to Figure 2, a desktop card printer **10** in accordance with the principles of the present invention may include one or more data couplers **18** in communication with the controller **14** and a data writer **16**, such that the controller **14**

25   controls the data output of the data writer **16** via a coupler **18**. As illustrated, the printer **10** of Figure 2 includes three couplers **18A**, **18B**, and **18C**, each in communication with the controller **14**, and each also in communication with one of the data writers **16D**.

A coupler **18** converts instructions from one form used - such as the form used by the controller **14** - into another form that is used by the data writer **16**.

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As shown, some data writers **16** in a given printer **10** may utilize couplers **18**, while others may not. Among the data writers **16** referenced herein, smart card contacts are most likely to utilize couplers **18**. The type, number, and methods of communication of smart card chips varies considerably from chip to chip, and hence

5   from card to card. This is at least in part because of the versatility of smart cards and their chips; since the purposes for which a smart card can be used may vary greatly, the system used to program the chips themselves also may vary greatly. In addition, smart card chips may be provided by third parties, and third party devices - i.e. couplers **16** - may be necessary to write data to those chips.

10   Thus, in order to provide flexibility of use, it may be desirable to include multiple couplers **18** in a printer **10**. These couplers **18** typically will be utilized in communication between the controller **14** and smart card contacts. However, communication between the controller **14** and a smart card contact does not necessarily require couplers **18**. Likewise, couplers **18** also might be used in communication

15   between the controller **14** and other types of data writers **16**.

As shown in Figure 3, communication with the a data writer **16** that utilizes couplers **18** will not necessarily involve the controller **14**. In the arrangement shown in Figure 3, couplers **18A**, **18B**, and **18C** are each in communication with data writer **16D**, but are not in communication with the controller **14**. Instead, couplers **18A**,

20   **18B**, and **18C** are in communication with coupler communication links **20A**, **20B**, and **20C**, respectively. Coupler communication links **20A**, **20B**, and **20C** in turn are in communication with the host **30**.

As previously noted, couplers **18** typically are used with a smart card contacts. In the case illustrated in Figure 3, data for data writer **16D** bypasses the

25   controller **14**. This may be advantageous when, for example, the data to be written to the card is merely digital information that is "dumped" into a smart card chip, without needing to be processed by the controller **14**. However, such an arrangement is exemplary only.

Coupler communication links **20** are somewhat similar to the external communication link **12**, in that they enable communication with devices external to the printer **10**. As with the external communication link **12**, the coupler communication links **20** not are limited only to connection with a host computer **30**.

A variety of connections may be suitable for use as the coupler communication links **20**. USB ports are known to be useful as coupler communication links **20**. However, this is exemplary only, and other links may be equally suitable.

As may be seen in Figure 3, the embodiment of a desktop card printer **10** therein has a total of four communication links: an external communication link **12**, and three coupler communication links **20**. Although, as noted above, there may be advantages in having multiple couplers **18**, and/or in having coupler communication links **20** that bypass the controller **14**, as the number of communication links increases the complexity of the printer **10** also increases, and the potential difficulty in properly connecting and maintaining connections with a host **30** or other external agent also increases.

In addition, as noted previously with regard to Ethernet connections, direct connections such as those shown in Figure 3 between the host **30** and the external communication link **12** and coupler communication links **20** may be in some ways limited, at least with regard to access from a network. Individually converting direct connections, such as USB connections, into network-capable connections, such as Ethernet connections, can increase complexity still further.

Thus, as shown in Figure 4, certain embodiments of a desktop card printer **10** in accordance with the principles of the present invention may include an internal USB hub **22**. In the embodiment shown therein, the printer **10** connects to a host **30** via an external communication link **12**.

The external communication link **12** is in communication with the controller **14**. Thus, the controller **14** is in communication with the external communication link **12** as in Figures 2 and 3, but via the internal USB hub **22**.

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The internal USB hub **22** also is in communication with three couplers **18A**, **18B**, and **18C**. As in Figure 3, communication with the couplers **18** bypasses the controller **14**. However, because the printer **10** includes an internal USB port **22**, the couplers **18** do not require separate connections with the host **30**, and the connection

5   between the printer **10** and the host **30** is simplified thereby.

The USB hub **22** is internal to the printer **10**. It is not a separate device, and therefore does not require additional external connections to be made between it and the printer **10**. However, the USB hub **22** may be essentially a self-contained device disposed within the printer **10**. Alternatively, the USB hub **22** may be fully

10   integrated into the printer **10**, such that it may share circuit boards, grounds, a power supply, etc.

USB hubs are known per se, and are not further described herein.

In a preferred embodiment of a desktop card printer **10** in accordance with the principles of the present invention, decision-making and data-processing are

15   primarily or entirely internal to the printer **10**. That is, image processing and decision-making immediately related to printing is performed within the printer **10** itself, typically within the processor **14**. Thus, once the processor **14** receives a print command, i.e. from the host **30**, further input is not required.

For example, if a color image is sent for printing from the host **30** to the

20   printer **10**, the controller **14** itself determines which data writer(s) **16** should be used to produce an appropriate color image on a card, and what parameters (i.e. image scale) should be used for printing the image. The host **30** does not need to "know" or determine whether there is a suitable data writer **16** in order for printing to take place. Likewise, the host **30** does not need to process the image data into a form suitable for

25   the data writer(s) **16** that are used for writing the data. Once the host **30** initiates printing, printer **10** itself handles the necessary processing, and prints the image.

Such internal processing is not limited only to the above examples. Depending on the details of a particular embodiment of the desktop card printer **10**, the

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processor **14** may perform other sorts of image processing before or during printing. Other processing not specifically described herein also may be performed.

Image processing per se is known, and is not described further herein.

In addition to performing processing operations, printing in a desktop card printer **10** in accordance with the principles of the present invention may include decision-making.

For example, when data is sent from the host **30** to the printer **10** for writing onto a card, the controller **14** itself determines which data writer(s) **16** are most appropriate for writing the data.

In some cases, this may be a matter of selecting a data writer **16** based on the medium of the data in question, for example selecting a magnetic write head for use when writing data to a magnetic stripe.

However, such decisions may be somewhat more subtle. For example, as noted previously the combination of cyan, yellow, and magenta inks in CYM color printing on a card may not produce an equivalent image to one made using black ink. In such instance, the processor **14** may select whether to print using a CYM color print head, or with a black and white print head, depending on the effect that is to be produced.

Similarly, if a CYMK print head is used, the processor **14** may control the print head itself in detail, selecting which portions of an image are to be printed thereby using a combination of cyan, yellow, and magenta and which portions are to be printed in black.

Likewise, the processor **14** may select which of several print heads to use for a particular type of image. For example, as noted previously, bar codes may preferably be printed using a resin print head, rather than a dye sublimation print head.

Thus, decision-making may include selecting a single data writer **16** from among several to perform an entire print job. In such case, the printer **10** may select a data writer **16** with the controller **14**, and command the selected data writer **16** with the controller **14** so as to write data to the card using the selected data writer **16**.

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However, selection also may include selecting two or more data writers 16 to each perform a portion of a print job. In such case, the printer 10 may select first and second data writers 16 with the controller 14, and command the selected data writers 16 with the controller 14 so as to selectively write data to the card using the selected data writers 16, some of the data being written by the first data writer, and some of the data being written by the second data writer.

It will be understood that such decision-making is not limited to only two data writers 16, but may encompass essentially any number of data writers 16, either of the same or of different types.

In addition, decision making in the printer 10 is not limited only to selection of data writers 16. Where two or more couplers 18 are available for use with a particular data writer 16, the controller 14 may determine which coupler 18 is most appropriate for communicating the data to the appropriate data writer 16.

As with image processing, decision making in a desktop card printer 10 in accordance with the principles of the present invention is not limited only to the examples provided herein.

Because processing and decision-making are performed within the printer 10, the demands placed on the host 30 are relatively few.

Such an arrangement does not necessarily preclude input from a host 30 that would affect processing and decision making. However, such input is not required.

As described previously, in a desktop card printer 10 in accordance with the principles of the present invention the controller 14 is a PCL® controller, using an extended version of PCL®. Extensions may be used to enable some or all of the processing and decision making functionality described above.

The base version of PCL®, being employed to control paper printers, does not enable functions that would not be used by a paper printer. For example, neither magnetic stripes nor smart card chips are conventionally utilized in paper printing, and the use of multiple print heads is limited at best. At the time this application is filed the base version of PCL® does not include features to enable writing

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of magnetic data to a magnetic stripe or smart card data to a smart card chip, and provides little or no support for the use of multiple print heads to print data. Moreover, at the time this application is filed the base version of PCL® also does not include a mechanism for making a decision to write magnetic data or smart card data, and

5   provides little or nothing in the way of a mechanism for selecting from among multiple print heads.

It is specifically noted that extensions may be used, therefore, for performing at least the image processing and decision-making operations described above. However, the present invention is not limited only to those extensions

10   specifically identified herein, or to extensions only for image processing and decision-making.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope

15   of the invention, the invention resides in the claims hereinafter appended.